The world's demand for energy is constantly growing, especially in China and India. It is foreseen that by 2040 it will grow up to 45%. Finding a safe, clean source of energy has become priority. Nuclear fusion may be a potential solution of this energy problem. Current research related to thermonuclear fusion is focused on the development of construction materials for elements of the first wall in a future fusion reactors. Reduced activation ferritic/martensitic steels (RAFM), (like EUROFER 97, F82H or CLAM) are currently under consideration. All of them are based on the steel for high-temperature applications T92. The composition of RAFM steels compared to commercial 9Cr-1Mo steels differs in the replacement of high activation alloying elements such as Mo, Nb, Ni and Co, Ta, W and V with low activation elements to reduce the activation of the material and ease nuclear waste disposal. RAFM steels show good operational performance in the temperature window 350°C-550°C. However, in a future fusion reactor RAFM steels will have to withstands temperatures higher than 550°C.

The goal of this work is to develop a termo-mechanical treatment of RAFM steels aiming at an extension of its operational temperature window. Different works report that significant improvements of the macroscopic properties (also high temperature performance) of RAFM steels can be obtained by controlling the microstructure during a dedicated thermo-mechanical treatment.

It is planned to conduct different thermo-mechanical treatments on T92 steel to vary with this the microstructure of the material to obtain in the end a strengthened material.

In the first step physical simulations of the different thermo-mechanical treatments will be conducted to choose the most promising thermo-mechanical treatment of the material.

After conducting the different thermo-mechanical treatments on different batches of the material, detailed investigations of the microstructures by electron microscopy and investigations of mechanical properties are planned. These studies will clarify the changes in microstructure and their influence on mechanical properties.

In a future fusion reactor hydrogen isotopes will undergo a nuclear reaction, thus, producing large amounts of energies which will be converted to electricity. Hydrogen is, hence the fuel for the reaction and should not be lost in the wall. Materials in general can retain hydrogen. In materials used in a fusion reactor, this hydrogen retention should be small. Therefore, it is important to study the T92 steel after the different thermo-mechanical treatments on hydrogen retention. These studies will give insight which thermo-mechanical treatment will result in low hydrogen retention and good mechanical properties.